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ABSTRACT

The purpose of this paper is to aid curriculum specialists, state personnel, local supervisors, and teachers of industrial education in assessing the status of current instructional and curriculum materials developed for the study of manufacturing within an industrial arts curriculum. A literature review was conducted by means of three computer searches of ERIC journals and other relevant indexes. "Manufacturing", as part of the industrial arts curriculum, has a commonality of content which may be presented to students through simulated learning activities in a variety of classroom and industrial settings. A model for program development was recommended in order to meet the educational needs of people from Kindergarten through post doctorate levels for curriculum materials on manufacturing, which are presently emphasized mainly as an overview course for the middle grades or junior high school level. This model is entitled "Common Body of Knowledge for Management Consultants". A comprehensive educational delivery system for manufacturing curriculums should be further developed to present this common body of knowledge. (Author/AG)

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review and analysis of instructional materials for

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REVIEW AND ANALYSIS OF

INSTRUCTIONAL MATERIALS FOR MANUFACTURING

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FOREWORD

A comprehensive study of the manufacturing industry as a part of the industrial arts curriculum area has become widely accepted in the past decade. The resultant demand for manufacturing related curriculum and instructional materials has stimulated program development. The authors cite examples of significant operational programs and propose criteria for identifying and evaluating curriculum. This publication should aid curriculum specialists, state and local supervisors, and teachers of industrial education in assessing the current status of curriculum and instructional materials development for manufacturing.

The profession is indebted to Rex A. Nelson and Lewis R. Selvidge, Jr., Industrial Technology Division, Georgia Southern College, for their scholarship in the preparation of this report. Recognition is also due Willis E. Ray, The Ohio State University; and Jack C. Brueckman, Jr., State University College at Buffalo, for their critical review of the manuscript prior to final revision and publication. Wesley E. Budke, Assistant Director, Information Utilization at The Center coordinated the publication's development.

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INTRODUCTION

"Manufacturing" has been included as part of the industrial arts segment of the industrial education curriculum area in recent years. Inasmuch as the mission of industrial arts is to develop an understanding of industry from the standpoint of assisting learners to live and pursue a living in a society which is often termed industrialized, it would appear that the industrial arts curriculum area has the responsibility of presenting a total view of industry to help make for an enlightened citizenry. Consequently, industrial arts students should acquire knowledge of the manufacturing system in order to obtain a realistic interpretation of this aspect of industry.

Although the idea of utilizing elements of the manufacturing industries in industrial education curriculum is nothing new, the practice of including a total study of the manufacturing industries through the use of a method or study entitled "Manufacturing" has become acceptable only within the past decade. This practice has become a part of the industrial arts segment of the industrial education curriculum area and has reached national magnitude.

Statement of the Problem

The purpose of this paper is to aid curriculum specialists, state personnel, local supervisors and individual teachers of industrial education in assessing the current "state-of-the-art" of curriculum and instructional materials developed for the study of "manufacturing." "Manufacturing" is that portion of the industrial education curriculum area where learning experiences are presented which relate to man making goods in quantity for a profit by means of production processes. These learning experiences are further identified as those presented in the industrial arts segment of the industrial education curriculum area.

The problem for study presented three needs: first, a model which would relate to the real world of manufacturing as opposed to an educational model; second, a means for identifying and analyzing the literature; and third, a method which would assist others in assessing their work and study in the area of "Manufacturing." The model selected to satisfy these three needs includes the structure of manufacturing enterprises and the activity areas, functions, and subfunctions identified in the Common Body of Knowledge for Management Consultants (Common Body, 1957). The major components of the model are: Structure of Enterprises; Management; Research and Development; Production; Marketing; Finance and Control; Personnel Administration; External Relations; and Secretarial and Legal.

These major components were used as the criteria for identifying and selecting literature which presents examples of curriculum and instructional materials reflecting the study of "Manufacturing." The criteria were also used for evaluating strengths and limitations of the curriculum and instructional materials presented in the literature.

LITERATURE REVIEW AND ANALYSIS

Search for Literature

Three computer searches were used to identify documents with pertinent information related to the "state-of-the-art" of the study of "Manufacturing." One search was conducted in Research in Education (RIE), another in the Abstracts of Instructional Materials in Vocational and Technical Education (AIM), and a third in the Abstracts of Research Materials in Vocational and Technical Education (ARM). Because the bulk of periodical literature which is available was not included in these computer searches, a number of additional indexes and journals were searched. This search included Dissertation Abstracts; Reader's Guide to Periodical Literature; Education Index; Industrial Arts Index; Addresses and Proceedings of the Annual Conventions of the American Industrial Arts Association; and the Yearbooks of the American Council on Industrial Arts Teacher Education.

The literature reviewed was selected for its direct relationships to the present "state-of-the-art" of "Manufacturing" curricula. Because of the interrelatedness of content, method, and instructional materials, literature which referred to such topics as mass production, line production, group projects, quantity production, study of functions and elements of industry, and various titles of innovative curriculum projects was considered as directly related to "Manufacturing." In reviewing these related writings, it is obvious that literature inherent to the curriculum area is a continuance from early to present day writings. Chronological writings were studied, but, only the more recent were included as pertinent.

The information below is arranged to provide a chronological growth and geographical view of this emerging curriculum area. Additional pertinent information may be found in references presented in the bibliography.

Selected statements from the articles are given along with a classification of the activities reported in the literature. The classification of these activities is based on the selection criterion presented in the statement of the problem.

The materials given below involve various professional levels, grade levels, instructional materials and areas, and curriculum breadths from an individual teacher to a national scope.

Current Efforts

Cuthbert and Worthington (1956) wrote that in mass production "most of

the students (senior level) were amazed at the relative speed and ease of production using a simulated industrial method." This method included activities related to quantity production, management, research and development, production, and personnel administration.

Schaffer (1957) used "The Mass Production Technique of Teaching Industry" with junior high students. Through this technique he involved students with both classroom and laboratory activities which involved the profit motive, quantity production, management, research and development, production, marketing, finance and control, and personnel administration. He stressed that "this is an education technique, not a better method for producing more and better 'pump lamps'" (Schaffer, 1957).

The expansive possibilities of both the content and method of this curriculum area presented a challenge. Spencer (1959) said:

> Use your imagination - go all out with this idea. Give a little imaginative thought to such industrial considerations as wages, labor unions, rent, depreciation, taxes, utilities, workmen's compensation, advertising capital, interest rates, stocks and bonds, packing problems, shipping problems, foreign market competition, insurance, etc. Just keep on thinking!

Others were more cautious. Walker (1960) stated that: "It is realized of course that mass production problems are not curealls, nor are they the easy road to teaching." However, Bernstein (1960) noted that: "The school-shop production job, in which the class undertakes to mass-produce and sell a consumer product, is the most dynamic and effective technique yet devised for achieving the above (an understanding of industry) objective."

The amount of teacher and class time alloted for involvement in the technique and content varied, with some teachers stating that: "We looked for a simple project of three or more pieces, one the students could produce, assemble, and finish in two or three class periods" (Green, Earl and Mills, 1961). Others reported on how to use the production situation to interpret industry on the junior high level with data on the role of the teacher, developing the product, breaking down the operations, constructing and using jigs and fixtures, routing and assigning personnel, the pilot run, the production period, and the follow-up (Rokusek, Schwartz and Swanson, 1962).

Claims were made that through the production process a better quality "project" is possible, which, in turn, presents a better image of industrial arts to teachers, parents and administrators (Bunting, 1963). But, it was also recognized that: "The true purpose of the industrial arts shop should also be to teach industrial methods of saving time and money in the manufacture of a product to be sold at a profit and not limited to the image" (Schwartz, 1962). Furthermore Peterson and Johnson (1961 stated that:

> While it is essential that the industrial arts area must not be considered a factory for the school, if valid industrial arts objectives can be accomplished while providing invaluable assistance to other departments, total education will profit by such interdepartmental cooperation....The main objective in utilizing this (mass production) project for industrial arts was to show the students how industry uses the assembly line to produce items more economically.

Through this technique "one will be astonished at the insight and understanding the average student will have about production techniques, processing, planning, control of materials, personnel problems, machine efficiency, etc." (Ball, 1963).

The "Manufacturing" approach of the industrial arts curriculum area also included an international aspect. An example was the cooperation between the Liberian Red Cross and the American Red Cross in 1964. The Liberian Red Cross asked for aid in reducing the incidences of hookworm by providing sandals to Liberians. The American Red Cross responded by enlisting the help of American junior high school industrial arts students. Dyson (1964) and Flagg (1964) reported on this project.

> The phase of this project carried out in American schools was developed in order to afford American students a practical project experience contributing to human need in three substantial ways: by developing a process that would serve the real needs of others; by contributing to students' education and understanding of the world in which they live; and by contributing an exercise capable of being assimilated into the school curriculum (Flagg, 1964:166).

In this experience the American students conducted all pre-manufacturing activities for a simple sandals-making process that Liberian students might themselves carry out, using tools and materials locally available, in order to make simple footwear for themselves and their families (Dyson, 1964 and Flagg, 1964).

District and State Development

In the early sixties the breadth of opportunities for utilizing "Manufacturing" in the industrial arts curriculum area was somewhat established. Industrial arts personnel appeared to seriously engage the question of manufacturing both as content and method and to relate it to objectives of industrial arts. It is interesting to note that industrial arts personnel now began to ask the question: What is industry?

Carrel (1965) states that:

> If industrial arts is to be a 'study of industry,' we must

> begin to think seriously about industry as a whole thing. Certainly modern industry is more than a collection of skilled trades or an aggregation of business enterprises. Many, perhaps most of the elements basic to industry as a functioning institution are known to us. It remains for us to classify them, to organize the body of knowledge emanating from them and to mold that body of knowledge into an educational discipline in our schools.

In attempting to implement the evolving knowledge of industry, the methods for delivering knowledge became an integral part of the total picture.

> To implement differentiated assignments in industrial arts environments, one may use four approaches. The first calls for varying the quantity of work for each homogeneous group; the second, for varying the difficulty of the work; the third, for varying the type of the work; and the fourth approach depends on utilizing a division of labor which calls for role-playing activities and the performing of different tasks by members of the class (Schad, 1965).

Schad continues by describing how a teacher can implement a study of manufacturing in his classroom. He indicates that an instructor may engage an entire class in a common activity involving the manufacturing process. This project offers great possibilities. By this method some students perform managerial activities, others carry out engineering and associated tasks and do production work. This method of teaching utilizes all the levels of student talent and permits a division of work commensurate with ability and interest (Schad, 1965).

Teachers actually involved in teaching at the classroom level are beginning to: 1) recognize how mass production relates to objectives of industrial arts; 2) describe the teacher preparation necessary prior to teaching; 3) describe elements of the actual teaching process; and 4) to detail units actually taught rather than projects to be made (Prichard, 1965).

Henak (1965), a junior high school teacher, outlines how his five classes are organized into five companies to study and carry out the functions of industry. This organization includes: Research and Development--involving the design of a product, isometric sketching, and research materials and methods; Planning of Production--involving sale of stocks, organization of personnel, a bank account, working drawings, production charts and layouts, quality standards, safety, and production scheduling; Production--involving custom, mass, job lot, and process production; Packaging and Distribution; Service--involving the development of a maintenance tag to be packed with the product; and with the suggested improvements of subcontracting between companies and an open house for external relations.

The increased involvement of industrial arts teachers in this curriculum development is observed in the breadth of content, different methods of teaching and student-teacher relationships to manufacturing (Israel, 1966). Hoffer (1966) comments:

> The application of a different classroom technique converted what would have been a routine electronics project into a new and interesting experience for a basic electronics course....The project was a small UHF receiver....Adding to the experience was the fact that the assembly line was set up and organized by the students, with the instructor acting in only an advisory capacity after introducing the concept.

Dutton (1966) recognizes the breadth of content and suggests that: "Rather than concern himself with the total production structure as found in industry, the teacher must set about to teach concepts to explore the advantages and limitations of mass production." Aiello (1966), while involving students in both laboratory and classroom activities related to management, research and development, production, marketing, finance and control, the profit motive, and quantity production, notes that students who were "Self-styled leaders proved bluffers....Trouble-makers proved potential leaders," and "Constant-failure students found success and satisfaction in performing one-operation jobs."

Regional Scene

Besides the numerous reports about individual teachers, schools, districts and states accepting "Manufacturing" as a part of the industrial arts curriculum area in the mid-sixties, reports also started to reflect a regional acceptance. At the 1966 national convention of the American Industrial Arts Association, Haynes (1966) reports that the "middle states" were incorporating units in mass production at the secondary level; Mindock (1966) reported on the "Mountain States"..."How We Get The Industrial Approach Into Industrial Arts In Our Region," indicating the inclusion was from ninth grade into the junior college; and Fox (1966) reports that in the West Coast States the most:

> ...effort has been concerned with the production and manufacturing phases of industry and little has been devoted to the departments of research, sales and distribution, management and labor, performance analysis, quality and production control, procurement of supplies and equipment.

Fox adds that: "It is rather obvious at this point that there has been little more than experimental teaching in this area. Most teachers realize an obligation here, but are frustrated in their token attempts to do a job."

National Curriculum Proposals

The acceptance of "Manufacturing" as an integral part of the industrial arts curriculum area began to develop as teacher education institutions, school systems and combined teacher education and school systems proposed innovative curriculum programs which specifically included aspects of "Manufacturing." Many of these innovative programs identified elements of manufacturing as a part of the proposed curriculum area. These programs include the: Alberta Plan; American Industry Project; Functions of Industry; Georgia Plan; Industrial Arts Curriculum Project; Industrial Arts Technology; A Study of American Industry Program; Industriology Project; Maryland Plan; and the Occupational, Vocational and Technical Program (OVT).

Cochran (1969a) reported on five of these innovative programs which identify with manufacturing. In his article, Cochran indicates:

> Programs ranging from the elementary school to the university level have been developed that made use of modern curriculum theory. Federal and private funds devoted to just three such ventures--the American Industry Project, Industrial Arts Curriculum Project, and Partnership Vocational Education Project--now total more than 2 million dollars, specifically designated to develop and implement new university and secondary school curriculums. Other approaches, such as the Functions of Industry Concept, the Galaxy Plan, the Maryland Plan, and the Orchestrated Systems Approach, have gained national recognition through major presentations at conventions, federally funded projects and recent publications....(This article) provides an overview of five relatively unsung but decidedly representative programs....The five programs are: The Correlated Curriculum Project; Interdisciplinary Vocational Education; The Richmond Plan; Industriology Project; and The Georgia Plan for Industrial Arts (Cochran, 1969a).

Of these five, two specifically concern manufacturing and activities related to manufacturing. First, in the Industriology Project:

> ...six major activities, found in most industries, form the basis for studies marking the first part of the program. They are: 1) product development and design; 2) internal finance and office services; 3) manufacturing or processing; 4) marketing; 5) industrial relations; and 6) purchasing (Cochran, 1969a).

Second, the Georgia Plan for Industrial Arts specifically identifies manufacturing as one of the areas students should study "to become familiar with the basic industries and their technologies" (Cochran, 1969a).

Five additional programs are identified in Part II of Cochran's (1969b) report: "These five secondary-school programs are: Crafts as a Vocation; The OVT (occupational, vocational, and technical) Program; Training for Families of Skills; The Alberta Plan; and the Industrial Arts Technology: A Study of American Industry."

Of these five, three programs are mentioned as having elements of manufacturing identified. The OVT Program states that: "At the 7th and 8th grade levels, experiences are related to an overview of 10 occupational areas" (Cochran, 1969b). Manufacturing is listed as one of these 10 occupational areas. At the ninth and 10th grade levels, focus "is on standards of excellence in skills needed in a family of occupations, and the common threads within that job family" (Cochran, 1969b). Manufacturing is included as one of the possible families, although elements of manufacturing, such as research and development, are treated as a separate family (Cochran, 1969b).

In the Alberta Plan, at the 10th grade level, "simulated industrial situations focusing on organizational structures, decision making, communications and authority configurations are provided as the student completes the building of a project" (Cochran, 1969b).

In the Maine Industrial Arts Technology: A Study of American Industry, "such things as mass production techniques, establishing an industry, research and development activities, manufacturing and marketing experiences, and other methodologies are given coverage" (Cochran, 1969b).

One of the major curriculum innovations receiving funding was the American Industry Project at Stout State University in Wisconsin. This project based its innovation on 14 major concepts. These concepts are "communication, transportation, public interest, finance, physical facilities, research, purchasing, industrial relations, marketing, management, production, materials, processes and energy (Face and Flug, 1966).

The authors of this project state that:

> Industry represents a major social institution which impinges upon the lives of every human being. Yet nowhere in the present secondary school curriculum is the study of industry given the degree of attention it warrants (Face and Flug, 1966).

Anderson (1971) provides a rationale for the American Industry Project and the developmental process for the curriculum, field testing and teacher preparation. He concludes that: "the basic teaching content is drawn from a source which is not generally understood by the average industrial arts teacher. The source of the content is the institution of industry."

Anderson further states that: "Only the development of concepts or

understanding would provide a practical and viable approach to the study of industry." He identifies 13 concept areas, as compared to the 14 concept areas identified by Face and Flug (1966). These 13 concept areas are: "Communications, Transportation, Finance, Property, Research, Procurement, Relationships, Marketing, Management, Production, Materials, Processes, and Energy" (Anderson, 1971).

Research and development of the Industrial Arts Curriculum Project (IACP) was started in 1965 as a joint effort of The Ohio State University and the University of Illinois.

> It is funded by the Bureau of Research of the U.S. Office of Education. The Project mounted a massive research and development effort which included not only a staff of industrial arts educators but also logicians, historians, philosophers, economists, sociologists, and specialists from all phases of industry (IACP Staff, 1969).

In progress reports on the project it is stated that:

> For years now there has been dissatisfaction in the field of industrial arts. New theories and new programs have been initiated at various times in an effort to revise and upgrade the courses being offered, but these innovations have met with only limited success...Another major difficulty which is plaguing industrial arts is the fragmented approach which is being used...What we have failed to identify in the past is an organized body of knowledge, a system of concepts, subconcepts and unifying themes which could apply to all of industry...The successful development of a program which efficiently transmits and extends such a body of knowledge could revolutionize the teaching of industrial arts in the United States (IACP Staff, 1969).

The outcome of this project was the development of two separate courses for the junior high school. One of these courses was called "The World of Manufacturing" and the other "The World of Construction." Field testing of the manufacturing course began in 1968 and was cycled through the demonstration schools, field evaluation centers and the project center through 1971. This project has resulted in a textbook, teacher's guide, lab manual and instructional aids including software and hardware being developed (IACP Staff, 1971a,b,c).

The project identifies three major divisions of manufacturing technology: (1) manufacturing management technology, (2) manufacturing production technology, and (3) manufacturing personnel technology. The units of study for these three major divisions and the course on "The World of Manufacturing" attempt to present "an organized body of knowledge, a system of concepts, subconcepts and unifying themes which could be applied to all of industry" (IACP Staff, 1969).

Another curriculum innovation which contains elements of manufacturing is the Maryland Plan for Industrial Arts. In this plan "The eighth-grade program would be a study of contemporary industry using the group project and the line-production experiences as the means for accomplishing such a study" (Maley, 1966).

In the Maryland Plan, elements of manufacturing are to be studied through the indepth study of an industry using the group project and the line production approach. In these approaches students organize to role play and perform activities of industry (Maley, 1966).

Spreading the Curriculum

With the advent of the innovative curriculum projects came numerous adaptions and degrees of acceptance of "Manufacturing" as an area in the industrial arts curriculum. The similarities of these courses, programs, and proposals disallow identifying them with any one of the major curriculum projects and would be redundant if presented entirely. Consequently, only a few of the more representative efforts will be presented to indicate the "state-of-the-art" to include "Manufacturing" as an area of the industrial arts curriculum.

J. Sullivan's (1971) description of "Industrial Arts as Enterprise" includes both classroom and laboratory activities which relate to quantity production, profit motive, enterprise structure, management, research and development, production, marketing, finance and control, personnel administration and external relations. He also reports:

> An enterprise is a business. It is generally well organized. What it produces and sells is greater than the sum of what it buys. What it produces and sells may be a manufactured product, a repair service, or any other service for which people are willing to contract (J. Sullivan, 1971).

At State University College, Buffalo, a "Manufacturing Technical Semester" was used for industrial arts students preparing to teach. This curriculum development study includes:

> ...content outlines and organizational patterns necessary to be prepared to teach about the principles of manufacturing they (the teachers in preparation) have identified through individual research during their industrial internship (Brueckman, 1970).

L. Nelson and Sargent (1967) report on the Ball State University teacher in preparation programs which involves mass production and the functions of industry as approaches to the industrial arts curriculum. Steele (1969) further describes this program. His report indicates that both classroom and laboratory activities related to the profit motive, quantity production,

enterprise structure, management, research and development, production, marketing, stock sales, and personnel administration are provided for "the understanding or interpretation of industry."

Elementary Grades. The inclusion of manufacturing concepts, activities and elements appear at the elementary grade levels. These innovative programs also appear as individual teacher, school, school system and university efforts.

Hilliard (1967) describes a "Sixth Grade Mass Production Activity" in a Maryland school. This activity was carried on for 60 minutes per week from the fall opening of school until Christmas. This activity was designed to show the efficiency of collective effort, the making of interchangeable parts, the advantage of executing simple operations on a repetitive basis, and tooling up for production.

Wonacott (1969) describes the Los Angeles City Schools' program for "Introducing Children to the Concepts of Mass Production." He reports:

> The elementary school teacher, whether male or female, is completely dependent upon resources outside of his own experience to initiate and carry through a manufacturing project. He seldom has an understanding of the basic industries, and the nomenclature of technology has little meaning.

Selvidge (1971) wrote of an effort in Georgia to provide elementary teachers in preparation with experiences and knowledge of industry. He reports on a program which demonstrates relative activities and functions of industry through a teacher prepared motivating manufacturing activity at the elementary teacher preparation level.

A National Defense Education Act (NDEA) Institute for Advanced Study in Elementary Industrial Arts at The Ohio State University presented elementary teachers with an interdisciplinary approach which involved both laboratory and classroom activities. These included the manufacturing aspects of the profit motive, quantity production, enterprise structure, management, research and development, production, marketing, finance and control, and personnel administration (The Ohio State University, 1968).

Junior High and Middle Grades. Although literature on the content, method and instructional materials of manufacturing exists for both elementary and high school grades, the largest collection places this part of the industrial arts curriculum at the junior high or seventh, eighth and ninth grade levels.

Literature written in 1967 presents the manufacturing approach with and without reservations. Wendelin (1967) describes a "Line Production" in a Maryland junior high school which includes both classroom and laboratory activities relating to the profit motive, quantity production, enterprise structure, management, research and development, production,

marketing, finance and control, and personnel administration. Monaghan (1967) provides a detailed procedure on how to produce step ladders, but cautions: "The purpose of the project, however, was not to make money; rather to bring about sound, basic understanding of one phase of industrial practice--mass production." H. Nelson (1967) describes his junior high program in California as a "unifying experience" and adds:

> The Production project is probably the most versatile of all the teaching devices available in industrial education. It can be used for skill development, and can involve problem solving, creativity, and almost any other objective desired.

The effects of some of the innovative curriculum projects are reflected in articles by teachers in the field. Smith (1969) writes on "Action in the Middle School" identifying with the Maryland Plan. Butler (1970) states that the major emphasis of the units in the junior high program is the "basic understanding of the functions of the basic elements of the corporate mass production industries" as provided in the Maine State Plan. Jackman (1970) specifically describes "Industriology for the Elementary Schools" and includes the seventh, eighth and ninth grades. His report identifies with six activities: development and design; purchasing; manufacturing or processing; internal finance and office services; and industrial relations and marketing, of the Industriology Project.

The 1968, 1969, and 1970 proceedings of the National Conference of the American Industrial Arts Association contain several reports on the "Manufacturing" part of the industrial arts curriculum area. Collins (1968) describes "An Experiment in Manufacturing" in an eighth grade class in Michigan. Barella (1968) provides a most complete description of seventh, eighth and ninth grade program in Parma, Ohio, which integrates the metals, drafting and graphic arts area into "A Study of Manufacturing Industries." Hacker (1970) discusses "A Seventh-Grade Industrial Arts Curriculum" involving three teachers in Syosset, New York, and which allows students to compare a handicraft process with a mass production process.

Institutes funded through the National Defense Education Act (NDEA) were utilized in the late sixties, both to assist teachers in preparing to teach and to develop materials for the study of manufacturing as a part of the industrial arts curriculum area. F. Sullivan (1969) reports on an institute concerning industrial production. This institute suggested three approaches to manufacturing in the middle grades: 1) a simple line production unit, 2) a mass production unit, and 3) a complete industrial organization.

An institute at Gorham State College (1968) in Maine prepared units based on pupil interest and representative manufacturing industries. Each unit was developed as a complete teaching package, containing purposes, activities, approaches, instructional resources, suggested lessons and lesson content, and unit evaluation.

During the summers of 1969 and 1970 an institute at Georgia Southern College in Georgia developed a guide for the manufacturing area of the industrial arts curriculum. This guide was a cooperative effort of practicing teachers, teacher educators, counselors, state personnel and consultants. The units for instruction can be identified with the elements of the Common Body of Knowledge for Management Consultants (Common Body, 1957) as they relate to manufacturing. The results of this institute became a Georgia State Department of Education publication entitled Industrial Arts for the Middle Grades--Manufacturing (Georgia State Department of Education, 1971).

Donald Hrabik (1968), ninth grade teacher, reported on his experiences with teaching the content and methods which evolved from an institute he attended. Hrabik reports that following the institute his students were presented a learning experience which involved a teacher directed project and both classroom and laboratory activities. These activities revolved around quantity production, enterprise structure, management, research and development, production, marketing, finance and control, and personnel administration.

Two other major publications also include the elements of manufacturing for the junior high level. The foreword of the curriculum guide, Industrial Arts, for the state of Utah states:

> The guide provides school district personnel, school principals, and industrial arts teachers with the basic instructional materials to effectively teach and explore the principles, processes and concepts of Production Technology (Utah State Board, 1968).

This guide includes the interdisciplinary approach, and both classroom and laboratory experiences. Activities are suggested which relate to quantity production, enterprise structure, management, research and development, production, marketing, personnel administration, secretarial and legal, and external relations.

In the 19th Yearbook of the American Council on Industrial Arts Teacher Education, Lindbeck (1970) describes elements of industry involved in performing the production task and provides a daily schedule for a teacher/class activity to study these elements while mass producing a quantity of products. In the same yearbook, Ray (1970) further identifies the three basic families of industry: manufacturing, construction and product service. He states that: "Manufacturing begins with a raw product or with several types of raw products and, by in-plant, mass-assembly production or other production techniques, manufactures a product classified as either durable or consumable."

Senior High. While the bulk of the literature on "Manufacturing" as a curriculum area relates to the junior high level, other articles consider the senior high level.

Faiks, et al. (1967) discuss a senior high study of the "Elements of Industry" which involve both classroom and laboratory activities related to quantity production, management, research and development, production, marketing, finance and control, and personnel administration. In this article Faiks, et al. note that:

> Consideration should be given to the fact that any course is but a vehicle. This particular vehicle is used to conduct a class on a meaningful and educational tour through industry. Teaching only a unit on mass production would be taking this trip with parts of the vehicle missing. The full educational tour would not be complete (Faiks, et al., 1967).

Bonfadini (1970) describes four approaches used in a senior high program in Virginia. The primary objectives of these approaches are to acquaint the students with "industrial organizations and processes, technology of manufacturing industry, the types of tools and machines used in industry, and historical and social significance of industry." He lists these four approaches as: 1) the unit approach which emphasizes "industry and its historical significance"; 2) the group approach for "the study of manufacturing industry"; 3) the mass production approach to describe the "American way" of manufacturing products; and 4) the individual project approach "for self-expression...vocational aspects...(and) craftsmanship and design."

Cawley (1970), a senior high teacher, outlines his program which presents elements of industry through a two plant arrangement. In this arrangement all the students are involved in elements of the manufacturing industry which relate to pre-production in Plant A. The students also participate at a different time in Plant B, which involves production and post-production elements.

Litman (1970) reports on changing "From the Traditional to the 'New Industrial Arts' in Fairfax County Virginia." In identifying this change, he notes that: "Simulation of the industry provided experiences in organizing, financing, product determination, tooling-up, production, packaging, distribution, and personnel role-playing."

The inclusiveness of "Manufacturing" in the industrial arts curriculum area can be observed in a "Case Studies" report of innovative programs by Householder (1972). It is interesting to note that all but one of the nine cases studied were strongly based in manufacturing or the study and experiencing of the functions of industry. Householder's nine case studies are:

> ...reports of locally sponsored innovations in industrial arts programs for students in one or more grades, six through nine. ...In general, schools which were closely affiliated with major industrial arts curriculum projects have not been included.

Teacher Preparation. In the preceeding reviews of literature on the elementary, junior high and middle grades, and senior high school programs which include "Manufacturing" as an element of the industrial arts curriculum area, it is obvious that many of these programs evolved from programs developed at teacher preparation institutions. These teacher preparation programs are brought to focus in the 20th Yearbook of the American Council on Industrial Arts Teacher Education. The editors of the yearbook recognize that neither the content nor the method for industrial arts education has been identified or structured. In the final statement of the yearbook, they state: "We challenge industrial arts teacher educators to continue the search for the technological components of content and method" (Streichler and Ray, 1971).

Although the above yearbook describes programs and approaches for the development of industrial arts teachers in general, it does not provide information on how to prepare industrial arts teachers for specific programs in the industrial arts curriculum area, such as "Manufacturing."

Ginther (1971) lists 26 "new, innovative, or experimental programs." Of these 26 programs, 20 are identified with colleges and universities. It would appear obvious that these colleges and universities would have teacher preparation programs for their "new, innovative, or experimental programs." From Ginther's (1971) list of 26 programs, probably the teacher preparation program for the Industrial Arts Curriculum Project "The World of Manufacturing" course has had the greatest impact.

In 1971, 27 "World of Manufacturing" summer workshops were held at 26 different industrial arts teacher preparation institutions across the nation. These workshops offered graduate credit and were open to all interested persons desiring to understand the Industrial Arts Curriculum Project rationale and course content; to learn how to utilize behavioral objectives, role-playing, production scheduling, and other effective teaching techniques; to gain a working knowledge of management and production practice utilized in the manufacturing industry; and, to become familiar with teaching procedures, student activities, and instructional materials used in "The World of Manufacturing" course (McKnight and McKnight, 1971).

The fact that teacher preparation programs are in a state of flux with regard to both method and content related to the study of "Manufacturing" is reinforced by research studies being conducted.

Stern (1964) discovered that the functions of goods-producing industrial establishments used as a base for his study were acceptable, but inconclusive. His study was based on the following functions of industry: 1) Fundamental and Applied Research; 2) Product Development; 3) Planning for Production; and 4) Manufacturing, Custom and Continuous. In his study:

> It is concluded that the textbooks, consultants, and management personnel were in substantial agreement with the proposal 'functions of industry,' as a universal framework for

understanding the activities of goods-producing industrial establishments. With respect to the specific 'functions,' however, numerous additions, deletions and subtractions were recommended.

Brueckman (1969) concludes that industrial arts educators tend to show disagreement with industrial experts regarding the major elements of manufacturing. He also found that there is little standardization or continuity in "Manufacturing" course titles, instructional materials, or methods in industrial arts teacher education institutions.

These studies tend to indicate a disagreement between educators and industrialists about what comprises the elements of manufacturing on which content in industrial arts "Manufacturing" should be founded.

Other studies have been conducted to determine the effectiveness of "Manufacturing" as an instructional method.

Ilott (1969) concludes that the two instructional approaches in his study, mass production and individual project, are not differentially effective for teaching content related to tools, operations, industrial organization, and materials.

Gephart (1969) utilized 10 classes of eighth grade students to do a comparison of two approaches to developing an understanding of industrial enterprise. The two approaches to teaching are: Approach A, the experimental approach which involves group activity in a student enterprise that plans and develops, produces, and distributes products; and Approach B, the control approach in which students make individual projects.

Gephart (1969) concludes that Approach A would be more effective than B in assisting youth in developing an understanding of industrial enterprise.

Summary of Literature

The literature on "Manufacturing" as a part of the industrial arts curriculum area indicates that it is included in elementary, middle, junior high and senior high levels, and teacher preparation programs.

One could only estimate how many more cases would be represented in all grade levels, and by major industrial arts curriculum projects if the scope of Householder's (1972) case studies had been all inclusive. The amount of literature for review also would be greatly increased if more of these innovative programs were reported.

The literature shows that early authors had differing opinions on the value of "Manufacturing" as a part of the industrial arts curriculum. Some early authors were careful to state that the mass produced project was not

a panacea, while others made educational claims for both the content and method of "Manufacturing" without reservations.

Articles which include elements of "Manufacturing" as mass production were written primarily around the project or product to be produced with details on shape, design, and process for producing the project. The elements of industry were only mentioned as values for the student.

Literature of a later date presents the values of "Manufacturing" as a part of the industrial arts curriculum area almost without reservation. Many authors claim that the industrial arts curriculum area is not serving its purposes if the totality of industry is not being presented. "Manufacturing" is acclaimed by some teachers to be one of the best ways to present this total learning experience. These later articles also place more emphasis on the concepts and elements of industry to be studied and how to bring these experiences to students, than they do on the project or product to be made.

EXAMPLES OF PROGRAMS

The examples of programs which include "Manufacturing" as a part of the industrial arts curriculum area range from single teacher and one class situations to schools, systems, states, regions and national curriculum projects. In these examples, practices have been developed by individuals or groups of teachers and administrators without extra funding, and others have been developed through funding sources, such as the U.S. Office of Education. This may indicate that there are either "spin-offs" of funded projects or that funded projects are developed from innovations initiated in the schools.

The inclusion of "Manufacturing" in the industrial arts curriculum area also ranges from the student mass producing a "quickie" project developed by the teacher in two or three class periods to several classes organized to study and carry out functions of industry. "Manufacturing" also is included as one of two courses developed for national use. This course developed in the Industrial Arts Curriculum Project is entitled The World of Manufacturing (IACP Staff, 1969). Manufacturing also is a part of state plans for industrial arts as indicated by the curriculum guide, Industrial Arts, for Utah (Utah State Board for Vocational Education, 1968), and the publication entitled Industrial Arts for the Middle Grades--Manufacturing (Georgia State Department of Education, 1971).

The preceding provides a scope of the inclusiveness of "Manufacturing" in the industrial arts curriculum area at the teacher, system, state, and national levels. The preceding does not indicate the differientiated approaches, terminology, content and instructional materials which are a part

of these courses or programs. These diversities, while seemingly headed toward some commonality, evidently are an outgrowth of not beginning to think seriously about industry as a whole thing. They may have some base in the fact that many of the courses and programs are developed around a local area, hence, following a pattern of a local manufacturing industry rather than a body of knowledge emanating from industry, or the commonalities of manufacturing industries. The effect of emulating a local or singular manufacturing industry would result in examples of innovative "Manufacturing" courses and programs appearing diverse but containing many common elements.

This diversity in examples of innovative courses and programs makes it difficult to do more than just report on the courses or programs, as was done in the review of related literature. If commonalities do exist in these examples of courses and programs, they may be identifiable with the structure and activity areas of manufacturing enterprises.

CRITERIA USED FOR IDENTIFYING AND EVALUATING CURRICULUM

A review of the literature illustrates a common body of knowledge upon which to base content has not been accepted for the segment of the school curriculum which advocates and conducts a study to interpret industry and its technology, of which manufacturing is a part. This shortcoming has resulted in a diversity in the terminology used, in the emphasis placed and, in fact, in the content presented.

Because of the need to identify appropriate content for a study to interpret the manufacturing industry and its technology, it became necessary to conduct the evaluation of "Manufacturing" in the curriculum area.

The model accepted for use in conducting the evaluation was selected on the basis that it relates the study of "Manufacturing" to the real world of manufacturing industries, it provides a means for identifying and analyzing literature concerning the study of "Manufacturing," and it provides a method which can assist others in assessing their work and study in the area of "Manufacturing." The model consists of the structure of manufacturing enterprises, and the management principles, activity areas, functions, and subfunctions of industries as identified in the Common Body of Knowledge for Management Consultants (Common Body, 1957).

Therefore, the criterion used for the evaluation of curriculum and instructional materials for the study of "Manufacturing" is based on content identified by the model. Studies of "Manufacturing" were compared to the model to determine their inclusiveness of the study of content associated with the following criterion elements: structure of enterprises; management principles; research and development; production; marketing;

finance and control; personnel administration; external relations; secretarial and legal; and the functions and subfunctions of these activities. Figure 1 graphically illustrates the model base for criterion used to evaluate studies of "Manufacturing" with regard to content.

FIGURE I
CONTENT EVALUATION CRITERIA

Major Activity Identifier	Minor Identifier	Subidentifier
Enterprise Structure	Types	Subtypes
Managing	Elements	Subelements
Research and Development	Functions	Subfunctions
Production	Functions	Subfunctions
Marketing	Functions	Subfunctions
Finance and Control	Functions	Subfunctions
Personnel Administration	Functions	Subfunctions
External Relations	Functions	Subfunctions
Secretarial and Legal	Functions	Subfunctions

"Manufacturing" studies also identified according to their utilization of interdisciplinary approaches; both classroom and laboratory experiences; quantity production activities; monetary profit motive for operation; and introductory teacher prepared "quickie" production experience; prepared written materials; audio-visual materials; field trips; and consultants. Figure II illustrates the criterion used to identify studies of "Manufacturing" concerning teaching methods used.

FIGURE II
METHOD EVALUATION CRITERIA

Student Activities	Instructional Materials	Instructional Aids
Interdisciplinary	Textbook	Consultants
Classroom	Laboratory Manual	Field Trips
Laboratory	Workbook	Audio-visual
Profit Motive	Teacher's Guide	Samples
Quantity Production		Teacher Initiated
		Quickie Production

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

"Manufacturing" as a part of the industrial arts curriculum area has reached a degree of acceptance as evidenced by the examples of its inclusion in classes, courses, programs, curriculum guides and innovative curriculum projects throughout the nation. There is presently a diversity of nomenclature, terminology, content, emphasis, and instructional approaches to the teaching of "Manufacturing." There appears to be a commonality of concepts of "Manufacturing" and its elements which can be provided as learning experiences to meet objectives of industrial arts. Students, while somewhat reluctant to change to a new learning situation and knowledge, are reported to readily accept and pursue with interest the activity based experiences present in both the content identified with manufacturing or the identifiers in Figure I, and the educational method of "Manufacturing." Consequently, it can be stated that both content and method are being derived from manufacturing in the industrial arts segment of the industrial education curriculum area throughout the nation.

The development of the "Manufacturing" aspects of the industrial arts curriculum area has evolved through the works of innovative individuals early in the 20th century, through exemplary practices by teachers in the field, professional presentations, geographically centered approaches, and funded projects for program development.

Literature related to "Manufacturing" is present nearly in proportion to the stage of development. The literature reflects both the purpose of industrial arts to meet students needs, and the content, method and instructional materials developed for "Manufacturing" programs. The literature: 1) appears in operative form for the practicing teacher; 2) involves conceptual and behavioral bases for learning theorists; 3) presents state plans for state personnel; 4) presents approaches to curriculum management for supervisors and administrators; and, 5) contains implications for teacher education.

While the information regarding "Manufacturing" does not agree on terminology, content emphasis, or methods of approaches, there is a commonality of descriptions for these factors which could be compared to common phraseology and practices in both the educational and the real manufacturing industries.

Conclusions

It may be concluded that "Manufacturing" as an educational program is

part of the industrial arts curriculum area. Furthermore, it appears that "Manufacturing" has a commonality of content which may be presented to students through simulated learning experiences emulating the activities carried out in manufacturing enterprises. These simulated learning experiences evidently can be carried out in different laboratory and classroom settings while producing an unlimited variety of products. Instructional aids which have had an immense value in providing students with manufacturing learning experiences are available from manufacturing enterprises and educational sources.

The "Manufacturing" part of the industrial arts curriculum area is still a formative stage of final development. The diversity of content emphasis and limitations, and terminology established by published instructional and curriculum materials are accepted but being developed further in real school situations. From these factors it could be concluded that "Manufacturing" as a part of the industrial arts curriculum area has value for students in elementary, junior high or middle grades, senior high and teacher preparation programs. It could also be concluded that the greatest emphasis is presently as an overview course at the middle grades or junior high school level.

Recommendations

It is recommended that a common body of knowledge be developed or accepted for the "Manufacturing" part of the industrial arts curriculum area. Also to be considered is the serious attempt to meet the educational growth needs of people in educational setting from kindergarten through specialty training, or post doctorate levels. Since many of the concepts now being presented relate directly to the activities, functions and subfunctions presented in the Common Body of Knowledge for Management Consultants (Common Body, 1957), plus the enterprise structure and profit motive, it is specifically recommended that the body of knowledge involved in these activities, functions and subfunctions, structure and profit motive be accepted as common content for the "Manufacturing" part of the industrial arts curriculum area.

RESEARCH PRIORITIES

It is recommended that the research efforts of people in the curriculum area be directed toward further development of an educational delivery system for "Manufacturing" as a part of the industrial education curriculum area. It is further recommended that, if the activities, functions, and subfunctions outlined in the Common Body of Knowledge for Management Consultants (Common Body, 1957), the enterprise structure, and profit motive are unacceptable elements of a common body of knowledge, research priorities be given to developing a common body of knowledge of manufacturing

industries which is acceptable to both industrial consultants and industrial arts educators. Finally, it is recommended that an educational delivery system be developed for learners from kindergarten through specialty training, and for post doctorate work on a continuum rather than continuous base; and that instructional materials be further developed to assist in presenting a common body of knowledge for the various educational levels and settings.

APPENDIX

FORM FOR IDENTIFYING AND EVALUATING STUDIES IN MANUFACTURING

BIBLIOGRAPHICAL REFERENCE:

PROGRAM:

Location

Personnel

Scope of Study

Individual Teacher ..... _____
Single School ..... _____
School District ..... _____
State ..... _____
Regional ..... _____
National ..... _____
Unknown ..... _____
Other _____

School Level

Elementary ..... _____
Junior or Middle ..... _____
Senior ..... _____
Post Secondary ..... _____
College ..... _____
Unknown ..... _____
Other _____

CURRICULUM:

	Yes	No	Unk
Interdisciplinary	___	___	___
Classroom	___	___	___
Laboratory	___	___	___
Quickie Prod	___	___	___
Profit Motive	___	___	___
Quantity Prod	___	___	___
Enterprise Struct	___	___	___
Management	___	___	___
Res. & Devel	___	___	___
Production	___	___	___
Marketing	___	___	___
Finance & Cont	___	___	___
Personnel Admin	___	___	___
External Rel	___	___	___
Secretarial & Leg	___	___	___
Other _____			

INSTRUCTIONAL Materials

	Yes	No	Unk
Textbook	___	___	___
Lab Manual	___	___	___
Workbook	___	___	___
Teacher's Guide	___	___	___
Audio-visual	___	___	___
Field Trip	___	___	___
Samples	___	___	___
Other _____			

Quotes and Remarks - Reverse side:

Researcher: _____

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